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Article

Knowledge, Attitudes, and Practices Regarding the COVID-19 Vaccine for Children: A Questionnaire Survey at the 18-Month Health Check-Up

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Abstract: Background/Objectives: COVID-19 vaccination rate among children in Japan is low. This study aimed to address the knowledge, attitudes, and practices (KAP) regarding parental COVID-19 vaccine acceptance and hesitancy among parents with infants. **Methods:** We conducted a paper-based, household. Survey asked COVID-19 vaccination status, knowledge and attitudes among households with a vaccinated child, knowledge and attitudes among households with a non-vaccinated child, and intention to vaccinate among households with a non-vaccinated child. To analyze the factors associated with parental behavior, univariate and multivariate analyses were performed. **Results:** Response sheets were mailed to 1,060 households, and 960 children; and 665 respondents agreed to participate in the study. Only 3.8% of the children received the COVID-19 vaccine. In the multivariate analysis, parents who received three or more doses of the COVID-19 vaccine was associated with the child's vaccination status (adjusted OR 8.24, $p < 0.01$). Among respondents with a vaccinated child, 28.0% and 28.0% answered that vaccines can prevent long-term effects and complications and that COVID-19 is a serious infection, respectively. Sixteen percent said that social media platforms influenced their decision to vaccinate. Among the respondents with a non-vaccinated child, 38.9% answered that they had insufficient data on vaccine safety, while 26.7% answered that television and online news influenced their decision. Only 1.2% answered that they were planning to get the COVID-19 vaccine in the future. **Conclusions:** This KAP survey found a low rate of vaccination against COVID-19 among infants. These findings will contribute to the formulation of future public health practices.

Keywords: COVID-19; hesitancy; infant; vaccination; KAP study; pandemic

1. Introduction

As of July 2024, SARS-CoV-2 had infected more than seven hundred million people worldwide, including children, and had killed almost seven million people since the start of the COVID -19 pandemic [1]. Although children are known to have lower morbidity and mortality rates from COVID-19 compared with adults, immunocompromised individuals and children with some underlying conditions can experience severe symptoms [2,3], and even healthy children sometimes develop life-threatening conditions such as myocarditis and multisystem inflammatory syndrome [4–6].

Vaccines are an effective tool for reducing the incidence and mortality rates of COVID-19. Since 2020, more than 13 billion COVID-19 vaccine doses have been administered globally, and 73% of the world's population has received at least one dose as of July 2024 [7]. The efficacy and safety of the vaccine are well-established in children; past studies have confirmed that administration of the

COVID-19 vaccine to children aged 6 months to 5 years is safe and generates a sufficient immune response [8]. Furthermore, large-scale cohort studies have shown that COVID-19 vaccination is effective against infections of the Omicron variant and severe outcomes in children aged 0–11 years [9].

Despite these evidences, the vaccination rate among children has been low in some countries [10,11]. Previous studies found that child vaccination coverage and confidence increased with parental age [12–14]. Other factors, including parental vaccination status, previous influenza vaccination, educational attainment, annual household income, race/ethnicity, prior COVID-19 diagnosis, the vaccine approval process, and trust in the child's doctor as well as social media, are also associated with the likelihood of children being vaccinated against COVID-19 [10,15]. Vaccine hesitancy might persist during a future pandemic; therefore, it is necessary to analyze the factors that led to the underutilization of COVID-19 vaccines in children to develop better strategies for vaccine uptake.

In Japan, the BNT162b2 (Pfizer-BioNTech) COVID-19 vaccine was approved by the Ministry of Health, Labor and Welfare of Japan in February 2022 for children aged 5–11 years, and in October 2022 for children aged 6 months to 4 years. However, the Japanese government has not indicated a policy to promote COVID-19 vaccination for children, leaving the decision to vaccinate up to individual pediatricians and parents. As a result, the vaccination rate in Japan remains low. As of April 2024, only 4.5% of children aged 6 months to 4 years had received at least one dose, compared with 80.4% across all age groups [16]. A previous study has clarified that parental COVID-19 vaccine reluctance is strongest among parents with infants [17]. Thus, we aim to address the knowledge, attitudes, and practices (KAP) of this population in terms of parental COVID-19 vaccine acceptance and hesitancy.

2. Materials and Methods

2.1. Study Design, Setting and Population

This cross-sectional study was conducted from February to May 2024 in the city of Toyonaka, Osaka Prefecture. Having the second lowest COVID-19 vaccination rate among prefectures in Japan, Osaka Prefecture was considered a suitable target for investigating the reasons underlying the lack of success in vaccine promotion [17], while Toyonaka was chosen because it is a core city (a classification of Japanese cities based on certain criteria such as population size and economic importance). The population of Toyonaka is approximately 398,000 people, including 72,000 children. The average household income in Toyonaka is higher than the average household income in Japan, indicating a high economic level.

2.2. Sample Size

The effective sample size for a single population was estimated using Raosoft software (<http://www.raosoft.com/samplesize.html> accessed in October 2023). In Toyonaka, the annual number of births is 3,000 and the sample size was calculated considering a 95% confidence interval (CI), a 5% margin of error, and a 50% response distribution. Assuming a non-response rate of 10%, the final sample size was estimated as 375.

2.3. Sampling Methods

In Japan, health check-ups are mandatory for infants at 18 and 36 months of age. These check-ups include physical measurements, assessments of growth and development, and confirmation of vaccinations. We conducted a paper-based, household survey on the 18-month health check-up at Toyonaka Health Center. Questionnaires were distributed in coordination with the health center in advance to all households with 18-month-old infants, and the responses were collected on the day of the health check-up. We made efforts to minimize sampling errors by determining an adequate

sample size and maintaining consistency in our survey methods and question content, ensuring that the data obtained accurately reflected the entire population.

2.4. Questionnaire

All answers were multiple-choice, with an option for a free-form response if necessary. The questionnaire covered four domains. The detailed question content is provided in the Supplementary Material.

Domain 1: COVID-19 vaccination status in children aged 17–20 months

Vaccination status was reported by the child's parents or guardians. Answering "Yes" to the question of whether your child has received a COVID-19 vaccine was considered to indicate a vaccination history. The respondent also provided information on the number of doses their child had received and the child's age in months when the initial vaccination was administered.

Domain 2: Knowledge and attitudes regarding the COVID-19 vaccine in households with a vaccinated child aged 17–20 months

Households in which the child had received a COVID-19 vaccine were asked two questions. The first assessed the main reason for vaccination, while the second assessed the factors in the respondent's decision to vaccinate their child. The respondents selected the response that most applied to each question.

Domain 3: Knowledge and attitude regarding the COVID-19 vaccine in households with a non-vaccinated child aged 17–20 months

Households in which the child had not received a COVID-19 vaccine were asked two questions. The first assessed the main reason for non-vaccination, while the second assessed the factors in the respondent's decision not to vaccinate their child. The respondents selected the response that most applied to each question.

Domain 4: Intention to vaccinate against COVID-19 among households with a non-vaccinated child aged 17–20 months

Respondents with a child who had not received a COVID-19 vaccine were asked if they planned to have their child vaccinated in the future.

2.5. Analysis

Data entry and analysis were performed using R ver. 4.2.2. Using the answers from Domain 1, factors influencing the respondents' decisions to vaccinate their children were assessed. Univariate and multivariate analyses were performed using logistic regression to calculate crude odds ratios (ORs), adjusted ORs, p-values, and CIs. The dependent variable was the child's COVID-19 vaccination status, and explanatory variables were chosen based on their clinical relevance and included the following: Respondent's age, respondent's employment status, whether the respondent is a healthcare professional, respondent's vaccination status, whether the respondent has received the COVID-19 vaccine three or more times, family member's COVID-19 infection status, whether a family member experienced moderate to severe COVID-19, including death, whether the child was a premature baby, whether the child has any underlying medical conditions, whether the child has received routine vaccinations, and child's COVID-19 infection status.

The effective sample size for a single population was estimated using Raosoft software (<http://www.raosoft.com/samplesize.html> accessed in October 2023). In Toyonaka, the annual number of births is 3,000 and the sample size was calculated considering a 95%CI, a 5% margin of error, and a 50% response distribution. Assuming a non-response rate of 10%, the final sample size was estimated as 375.

2.6. Ethics Approval

This study was approved by the Committee for Ethical Review of Observational studies, National University Corporation, University of Osaka Hospital, School of Medicine (December 11,

2023). The study was conducted in accordance with the principles of the Declaration of Helsinki. A confirmation section regarding consent for the survey was provided at the beginning of the survey sheet, and respondents were asked to check if they agreed. The respondents were informed of the methods, use of data, purpose, and significance of the study, its anonymous, confidential nature, and their ability to withdraw consent at any time.

3. Results

3.1. Response

Response sheets were mailed to 1,060 households, and 960 children attended the 18-month health check-up. A total of 671 survey sheets were sampled and 665 respondents agreed to participate in the study. Among the respondents, 96% were women, and 11% were healthcare providers. The median age of the respondents was 34 years, and 28% were unemployed. In terms of the COVID-19 vaccination status, 16.4% of the respondents had no history of COVID-19 vaccination, while 53.4% had received three or more doses of the COVID-19 vaccine. The median age of the children was 19 months; 2.7% were born prematurely, and 3.6% had underlying medical conditions. Almost all (99%) of the children had received the standard immunizations (Table 1).

Table 1. Descriptive information of respondents and their children.

Respondents		
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Age (median [interquartile range])		34 [31, 37]
Gender (number, %)	Female	637 (95.8)
	Male	28 (4.2)
Relation to children (number, %)	Mother	637 (95.8)
	Father	27 (4.2)
	Others	1 (0.2)
Employment status (number, %)	Employed	368 (55.4)
	Self-employed	30 (4.5)
	Part-time	75 (11.3)
	Unemployed	188 (28.3)
	Others	3 (0.5)
Healthcare provider (number, %)		73 (11.0)
Number of COVID-19 vaccine doses (number, %)	0	93 (16.4)
	1	23 (4.1)
	2	242 (42.7)
	≥3	303 (53.4)
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Respondents' children		
Age (median [interquartile range])		19 [19, 19]
Premature (number, %)		18 (2.7)
Children with underlying medical conditions (number, %)		24 (3.6)
History of COVID-19 infection		
Number of times (N=658)	0	389 (59.1)
	1	266 (40.4)
	≥2	3 (0.5)
Symptoms and severity level (N = 270)	Asymptomatic	20 (7.4)
	Mild	249 (92.2)
	Modarate	1 (0.4)
	Severe	0
Number of COVID-19 vaccine doses (N = 665)	0	640 (96.2)
	1	5 (0.8)
	2	6 (0.9)
	3	14 (2.1)

3.2. Domain 1: COVID-19 Vaccine Status in Children

Only 25 (3.8%) of the children had a history of COVID-19 vaccination, with a median of three doses, and the median age at vaccination was 7 months (Table 1). In the statical analysis, most of the planned variables could not be assessed because no respondents who had vaccinated their children selected either answer. Only five variables could be analyzed: the respondent's age, whether the respondent is a healthcare provider, whether the respondent had received three or more doses of the COVID-19 vaccine, family member's COVID-19 infection status, and child's COVID-19 infection status. The univariate analysis revealed that whether the respondent had received three or more doses of COVID-19 vaccine and family member's COVID-19 infection status were associated with the child's COVID-19 vaccination status. However, in the multivariate analysis, only whether the respondent had received three or more doses of the COVID-19 vaccine was associated with the child's vaccination status (adjusted OR 8.24, $p < 0.01$) (Table 2).

Table 2. Results of univariate and multivariate analyses of factors influencing respondents' decisions to vaccinate their children.

Factor	Crude OR (95% CI)	Adjusted OR (95% CI)	P value
Respondent's age	0.99 (0.9–1.09)	0.96 (0.87–1.07)	0.481
Whether the respondent is a healthcare provider	2.23 (0.81–6.17)	1.52 (0.53–4.31)	0.987

Whether the respondent has received three or more doses of COVID-19 vaccine	8.79 (2.6–29.8)	8.24 (2.41–28.2)	0.001
Family member’s COVID-19 infection status	0.42 (0.18–0.98)	0.42 (0.15–1.16)	0.176
Child’s COVID-19 infection status	0.69 (0.29–1.63)	1.04 (0.37–2.91)	0.768

CI, confidence interval; OR, odds ratio.

3.3. Domain 2: Knowledge and Attitudes Regarding the COVID-19 Vaccine in Households with a Vaccinated Child Aged 17–20 Months

Among the 25 respondents who had their child vaccinated, 7 (28.0%) answered that their reason was the belief that vaccines can prevent long-term effects and complications. The same proportion also responded that COVID-19 is a serious infection that can lead to severe illness or death, even in infants and young children without underlying health conditions (Table 3). Regarding the sources that had influenced their decision to vaccinate, 4 (16.0%) indicated that their main source of information was social media platforms such as Facebook, Instagram, and Twitter (now X), where medical doctors and celebrities share information. Following this, television and online news, advice from their family, and advice from a primary care physician each accounted for 12% (Table 3).

Table 3. Main reason and sources influencing the decision to vaccinate the respondent’s child.

Main reason for vaccinating the respondent’s child	Number (%)
a. Because the people around you have been vaccinated	0
b. Because vaccination can prevent long-term effects and complications	7 (28.0)
c. Because you believe vaccines are safe	1 (4.0)
d. Because you believe that by vaccinating your child, you can prevent not only their own infection but also transmission to others around them	2 (8.0)
e. Because COVID-19 is a serious infection that can lead to severe illness or death, even in infants and young children without underlying health conditions	7 (28.0)
f. Because you considered the high risk of contracting COVID-19 for your child, who engages in group activities at nursery school or other facility	3 (12.0)
g. Other	1 (4.0)
Invalid response	4 (16.0)
Main sources influencing the decision to vaccinate their child	Number (%)
a. Social media platforms such as Facebook, Instagram, and Twitter (X), where medical doctors and celebrities share information	4 (16.0)
b. Social media platforms such as Facebook, Instagram, and Twitter (X), where your friends and acquaintances share information	0

c. Social media platforms such as Facebook, Instagram, and Twitter (X), where the city of Toyonaka shares information	0
d. LINE messages and YouTube videos from the city of Toyonaka	0
e. The Toyonaka municipal website and public relations magazine	0
f. Television and online news	3 (12.0)
g. Newspaper and magazine articles	0
h. The Ministry of Health, Labour and Welfare website	2 (8.0)
i. The Japan Pediatric Society website	2 (8.0)
j. Advice from your family	3 (12.0)
k. Advice from your co-workers and friends	2 (8.0)
l. Advice from a primary care physician	3 (12.0)
m. Advice from a public health nurse	0
n. Other	2 (8.0)
Invalid response	4 (16.0)

3.4. Domain 3: Knowledge and Attitudes Regarding the COVID-19 Vaccine in Households with a Non-Vaccinated Child Aged 17–20 Months Old

Among the respondents who did not vaccinate their child, 38.9% indicated that their decision was due to insufficient data on the safety of the vaccine, followed by 17.2% of respondents who expressed concerns about potential side effects (Table 4). Approximately 26.7% of respondents reported that the primary source of information influencing their decision was television and online news, followed by 16.7% who indicated that the main factor was advice from their family (Table 4).

Table 4. Main reason and sources influencing the decision not to vaccinate their child.

Main reason for not vaccinating the respondent’s child	Number (%)
a. Because the people around you have not been vaccinated	25 (3.9)
b. Because there is insufficient data showing the safety of the vaccine	249 (38.9)
c. Because you are worried about the side effects of the vaccine	110 (17.2)
d. Because you have experienced side effects from other vaccines you received in the past	1 (0.2)
e. Because vaccination involves pain	0
f. Because it has been reclassified as a non-emergent infectious disease under the Infectious Disease Control Law.	24 (3.8)

g. Because you believe that children have a low risk of developing severe symptoms even if they get infected with COVID-19 (i.e., that COVID-19 is not a serious infectious disease)	39 (6.1)
h. Because you believe that children have a low risk of getting infected with COVID-19	3 (0.5)
i. Because you believe that if the novel coronavirus mutates, the effectiveness of the vaccine will be diminished	5 (0.8)
j. Because your child has already had a prior infection with COVID-19	31 (4.8)
k. Because you do not have the time to get vaccinated	5 (0.8)
l. Because the places where your child can get the vaccine are limited and far away	1 (0.2)
m. Because your child has not received any vaccinations, including other vaccines	0
n. Because it takes time to obtain the vaccination coupon	2 (0.3)
o. Because it is cumbersome to make reservations at medical institutions	4 (0.6)
p. Other	39 (6.1)
Invalid response	102 (15.9)
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Main sources influencing the decision to vaccinate their child	Number (%)
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a. Social media platforms such as Facebook, Instagram, and Twitter (X), where medical doctors and celebrities share information	51 (8.0)
b. Social media platforms such as Facebook, Instagram, and Twitter (X), where your friends and acquaintances share information	8 (1.3)
c. Social media platforms such as Facebook, Instagram, and Twitter (X), where the city of Toyonaka shares information	0
d. LINE messages and YouTube videos from the city of Toyonaka city	0
e. The Toyonaka municipal website and public relations magazine	1 (0.2)
f. Television and online news	171 (26.7)
g. Newspaper and magazine articles	11 (1.7)
h. The Ministry of Health, Labour and Welfare website	7 (1.1)
i. The Japan Pediatric Society website	8 (1.3)
j. Advice from your family	107 (16.7)
k. Advice from your co-workers and friends	29 (4.5)
l. Advice from a primary care physician	18 (2.8)
m. Advice from a public health nurse	1 (0.2)
n. Other	107 (16.7)
Invalid response	121 (18.9)
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3.5. Domain 4: Intention to Vaccinate Against COVID-19 Among Households with a Non-Vaccinated Child Aged 17–20 Months Old

Of the 640 respondents with children who had not received any COVID-19 vaccines, 1.2% answered that they were planning to get the COVID-19 vaccine in the future, 32.0% answered that they were definitely not getting the COVID-19 vaccine in the future, and 64.7% answered that they would wait a while to see how the COVID-19 infection situation progressed or that they were not sure (Table 5).

Table 5. Intention to vaccinate one’s child against COVID-19 in the future.

Future plan to vaccinate your child	Number (%)
Planning to vaccinate your child in the future	8 (1.2)
Definitely not going to vaccine your child in the future	205 (32.0)
Wait a while to see how the COVID-19 infection situation is progressing or not sure	414 (64.7)
Invalid response	13 (2.0)

4. Discussion

This KAP survey revealed a low rate of vaccination against COVID-19 among children aged 17–20 months in Toyonaka, Osaka. Indeed, only 3.8% of children were found to have received at least one dose of the COVID-19 vaccine. This finding is in line with past surveys [14,15]. During the COVID-19 pandemic, although occasional cases with severe complications or deaths were reported, low vaccination rates did not lead to any serious consequences because of the low severity of COVID-19 in children [18]. However, it is important to elucidate the reasons underlying the low vaccination rates because there is no guarantee that children will have mild cases in a future pandemic.

The present survey revealed that parents receiving three or more doses of the COVID-19 vaccine was the most important factor associated with the likelihood of the child receiving one or more dose of the vaccine. This finding is in line with a previous study in which parents who received one or two doses of the COVID-19 vaccine were significantly more hesitant to vaccinate their children compared with those who received more than two doses [19]. At the end of April 2021, 2.0% of the Japanese population had received at least one dose of COVID-19 vaccination and at the end of October of the same year, the vaccination rate had risen rapidly to 80.0%. During this period, the momentum in society towards COVID-19 vaccination had grown as a result of various interventions: the mobilization of the Japanese Self Defense Forces, the establishment of mass vaccination slots targeted only at the younger population from teens to those in their thirties, and COVID-19 vaccination for athletes, coaches, and other individuals participating in the Tokyo Olympics. Given that the second dose of the COVID-19 vaccine was already being administered during this period, it is possible that more people were influenced by societal momentum to get vaccinated. Against this background, the decision on whether to receive a third dose may have been influenced less by societal momentum and more by each individual’s knowledge-based reasoning and action because the third dose of the COVID-19 vaccine started in Japan after the peak of the social momentum. It can be speculated that children are more unlikely to be vaccinated compared with other groups. Notably, this survey found that among children with underlying medical conditions, none had received the COVID-19 vaccine. These results highlight the fact that vaccines do not reach the children who truly need them.

This survey also reflects the respondents’ knowledges and attitudes toward vaccinating their children. The majority (56.1%) of reasons for not vaccinating children against COVID-19 were related to concerns about safety and side effects. This confirms the findings of past studies [15,19–22]. One-fourth (26.7%) of the respondents cited television or online news as the main factor that influenced

their decision not to vaccinate their children. This result contradicts past research findings on the relationship between COVID-19 vaccine uptake and information sources among adults. A previous study showed that individuals who relied on traditional news sources, including television, radio, news websites, or newspapers, were more likely to vaccinate their children compared with those who relied on other sources such as social media platforms [23]. Previous studies have reported that social media platforms have a negative impact on COVID-19 vaccination behavior [24]. However, in the present survey, only 9.3% cited social media platforms as a factor in their decision not to get the COVID-19 vaccine. Television and online news can disseminate information about COVID-19 vaccines to a large population at once. Thus, a method for swiftly assessing misinformation or inaccuracies using public-private partnerships is urgently needed.

Other trusted sources of information influencing the decision to vaccinate their children were television or online news, advice from their family, and advice from their primary care physician (12.0% each). As previous studies have revealed, recommendations and effective communication by primary care clinicians have a large impact on the decision to vaccinate [25,26]. Thus, pediatric providers need to communicate effectively to make vaccinations more accessible and must work to eliminate vaccine hesitancy in order to prepare for a future pandemic.

In Japan, vaccination coupons were automatically issued to adult citizens, but the decision issue them to children depended on the local government. Toyonaka did not automatically issue these coupons to children, instead requiring parents to contact the health office to obtain them [16]. Although only 2 respondents (0.3%) cited the difficulty of obtaining a coupon as a reason for not vaccinating their children, the government's passive approach may have deprived parents of the opportunity to consider vaccinating their children. The COVID-19 vaccination rate in Toyonaka was lower than the national average for infants (at least one dose: 4.5%), suggesting that there is room for improvement in making vaccines more accessible for children.

The findings of this study will contribute to the formulation of future public health practices. For households who received less than three doses of the COVID-19 vaccine, evidence-based communication between parents and primary care clinicians is needed. In addition, public-private partnerships should work to swiftly assess misinformation or inaccuracies. Furthermore, households with children having underlying medical conditions need to receive early guidance on various health risks associated with these conditions.

5. Conclusions

This KAP survey focused on the COVID-19 vaccine status of children under the age of 2 years. This survey confirms a low rate of vaccination against COVID-19 in Toyonaka, Osaka, especially among children with parents who received fewer than three doses of the COVID-19 vaccine. It also found that concerns about side effects and safety were significant factors underlying hesitation toward getting children vaccinated. Identifying the groups to be targeted with intervention as well as the attitudes among such groups suggest additional potential public health measures. The findings of this study may serve as a valuable contribution to preparedness for a future pandemic in an era where diseases can easily cross borders.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org, Table S1: Contents of the questionnaire

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, H.M., and S.K.; methodology, H.H., Y.K.; formal analysis, Y.K.; investigation, H.H., Y.K. resources, H.M., and S.K.; data curation, H.H.; writing—original draft preparation, H.H.; writing—review and editing, Y.K.; supervision, H.M., and S.K. All authors have read and agreed to the published version of the manuscript."

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Institutional Review Board Statement: This study was approved by the Committee for Ethical Review of Observational studies, National University Corporation, University of Osaka Hospital, School of Medicine (December 11, 2023). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent Statement: A confirmation section regarding consent for the survey was provided at the beginning of the survey sheet, and respondents were asked to check if they agreed. The respondents were informed of the methods, use of data, purpose, and significance of the study, its anonymous, confidential nature, and their ability to withdraw consent at any time.

Data Availability Statement: The data are not publicly available due to their containing information that could compromise the privacy of research participants.
This research received no external funding.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

KAP	Knowledge, Attitudes, and Practices
CI	Confidence Interval
OR	Odds ratio

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